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Body, Mind, and Spirit are Instrumental to Functional Health: A Case Study

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Abstract – The LIFEware[SM] System is an outpatient functional health outcomes measurement system designed using systematic application of probabilistic measurement models to item responses. Most item responses are acquired through patient self-report, though some measure as clinician assessed. The measures specifically target patient functional limitations in areas associated with activities of daily living, somatognosis, experience with pain, mood/affect/sleep/fatigue, cognition/memory, social interaction, role participation, behavior/value tendencies, satisfaction with treatment (comfort and function achieved), and community activities (participation and importance). In this case study of patient AR, LIFEware[SM] measures selected were: Body Movement and Control, Physical Limitations, Painfree, Placid, and Impact on Life. In addition, patient reports were collected with the PAR-PRO™ and Spiritual Tendencies Inventory®. LIFEware[SM] patient reports were captured using a likert-type, ordinal rating scale and transformed to an interval level rating scale of 0-100 with 100 representing better health function. The raw data ordinal responses were mathematically transformed using Rasch analysis into interval-level scales with axiomatic properties of additivity, probabilistic concatenation, and specific objectivity. Normative patient studies with LIFEware[SM] dimensions have facilitated development of functional benchmarks, which are valuable for efficient clinical patient classification. Results presented here provide an example of extraordinary insights provided by linear transformation of patient reports, and emphasize importance of supplementing organically determined pathophysiological disorders, as recorded on the medical record, with functional patient performance on key dimensions. In general, this research embraces principles of treating the whole person by performing a functional health review through survey and measurement of functional health attributes.

Keywords: Functional health measurement, outcomes measurement, outpatient rehabilitation, patient reported outcomes, Rasch model, LIFEware[SM] System

1. INTRODUCTION

Several decades ago, Engel emphasized the traditional medical model may be insufficient for identifying and quantifying certain deficiencies in a person's health [1]. Diagnoses based solely on traditional medical model assessments may misinterpret "true" dynamics of health issues, and overlook appropriate interventions that might improve life fulfilment. Supplementing traditional medical records with patient self-report of functional health may permit a closer realization of patient experience. Functional health evaluation implemented with appropriated measurement methodology today provides an alternative model for rehabilitation patients [2, 3]. Transformation of raw scores to linear measures should improve objectivity and comparability of patient self-reports. Purpose of this presentation is to demonstrate effectiveness of a measurement-based approach to functional health outcomes with a case study.

2. METHODS

2.1 Participant

AR is a 38-year-old woman evaluated 1/15/2010 because of pain more than 3 years after a motor vehicle accident in which she sustained injuries to the neck, left arm, lower back, and left lower limb. She never lost consciousness, but the accident resulted in chronic headaches. Prior to the accident she was physically active. A head CT scan and X-rays of chest, ribcage, and hip were normal; a cervical MRI showed a small tear at C5-6 and a mild bulge at C4-5 and C6-7; and a lumbar MRI showed minimal disc degeneration at L4-5 and L5-S1 without stenosis. She was prescribed numerous medications and received physical, chiropractic, and massage therapies. Currently she reports: pain in the neck, right shoulder, and upper and lower right limb; sharp headaches; and dizziness with certain head positions. The medical record includes leg pain has shifted left to right, related to fibromyalgia.

2.2 Measurement model

Conjoint probabilistic Rasch models were developed by the Danish mathematician, Georg Rasch, to transform ordinal raw scores into objective, linear measures on abstract dimensions that are independent

of specific population parameters [4]. Rasch model transformation mathematically relates β and δ together in the following expression,

$$\Pi_{nix} = \frac{\exp \sum_{j=0}^{x} [\beta_n - (\delta_i + \tau_j)]}{\sum_{k=0}^{m} \exp \sum_{j=0}^{k} [\beta_n - (\delta_i + \tau_j)]} \quad (1)$$

where β = observations, δ = item difficulties, and τ = rating scale thresholds. Π_{nix} is the probability any item δ, will be rated X by participant β_n where X takes a value from a fixed range (j = 1, 2, 3, 4, 5, 6, . . . n), m = number of steps for an item, and k = ith step. Model prediction (P) for each item and observed ratings (O) are statistically analyzed (O-P) for significant departures from expectation with Chi-square analysis. When raw data fit a Rasch model, measured differences between observations have an explicit unit. Statistical estimation of model parameters implements an empirical probabilistic concatenation procedure. Rasch models are the only probabilistic models in contemporary use that does so.

Rasch models are commonly implemented in rehabilitation medicine, because they have much stronger objective measurement properties than alternative methods for quantifying patient self-reports [5]. Unlike typical ordinal scales, Rasch models transform raw scores to equal-interval measures with an explicit unit of measure (log/odds) that is estimated independently of specific samples. Objectivity and several other measurement properties associated with this transformation are summarized in Figure 1, where these properties are presented as measurement pillars and their consequences summarized for patient self-reports [6]. These pillars, namely, objectivity, invariance, linearity, precision, and simplicity establish foundations not only for solving practical measurement problems, but also have epistemological implications for new scientific knowledge about patients and health. For example, objective equal-interval scales establish measures that maintain meaningfulness across multiple samples, as well as periodic comparisons even when survey forms have changed. Likewise, axiomatic additivity, which characterizes Rasch scales is essential for demonstrating incremental improvement of patients' functional health. Epistemologically, additive scales based on concatention procedures establish empirical foundations for conceptual entities, which are central to scientific conceptions.

2.3 Instruments

Transformation of raw scores to linear measures with WINSTEPS software [7] was conducted for following assessments:

- In the LIFEware[SM] System, Rasch models transform rehabilitation outpatient self-reports of functioning with more than 130 measures, scales, and instruments, which are mapped to World Health Organization's International Classification of Functioning, Disability, and Health (ICF) [8].

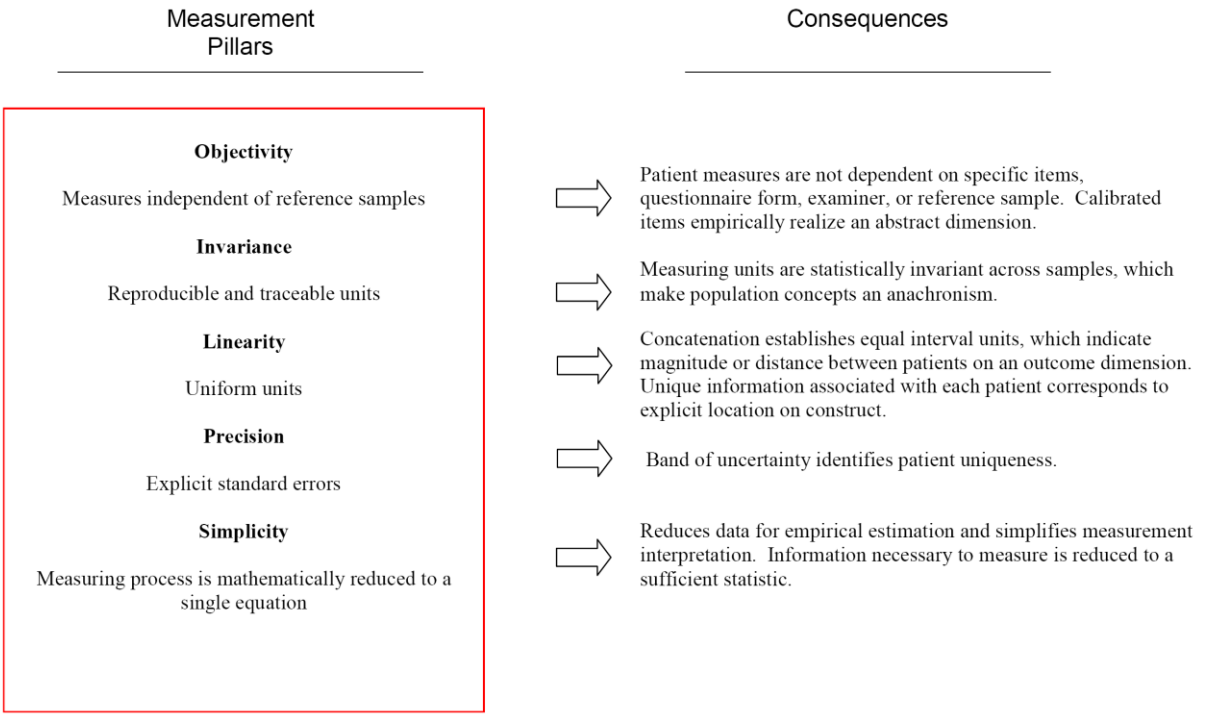

Figure 1. Pillars of scientific measurement have explicit consequences for rehabilitation medicine.

- Figure 2 presents mapping of LIFEware[SM] into the broader ICF system. In LIFEware[SM] outpatient limitations are parameterized as measures of activities/somatognosis, experience with pain, mood/affect/sleep/fatigue, cognition/memory, social interaction, role participation, role participation, behavior/value tendencies, satisfaction with treatment (comfort and function achieved), and community activities (participation and importance).

- PAR-PRO™ is a 20-item instrument of home and community participation for patients with disability that documents participation in certain activities and their importance [3].

- Spiritual Tendencies Inventory® is a survey of spiritual strengths and obstacles [9].

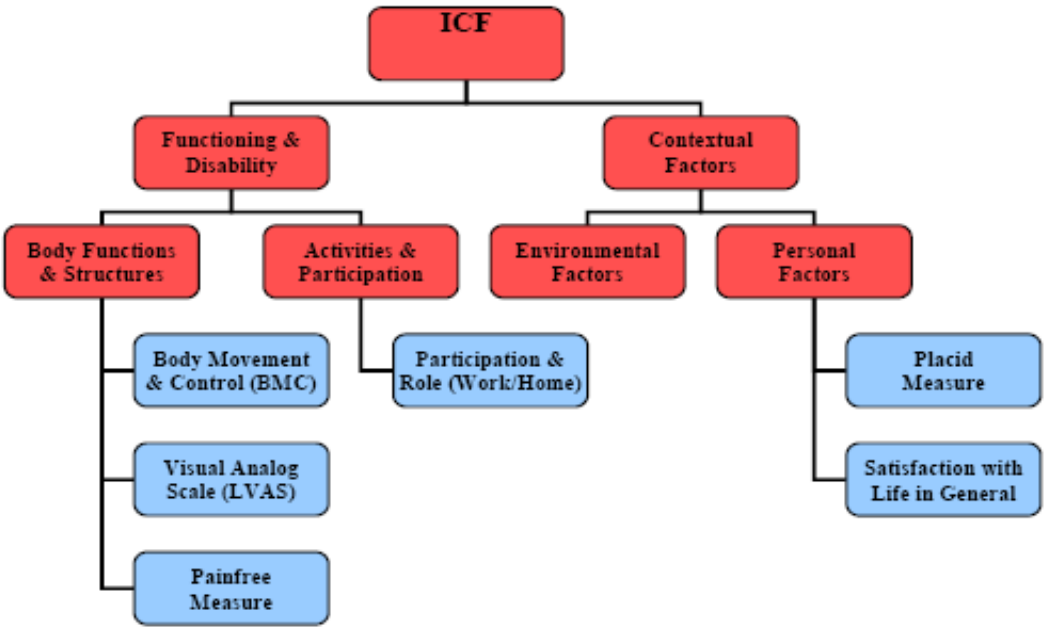

Figure 2. LIFEware[SM] system measures mapped to the International Classification of Functioning, Disability, and Health (ICF). World Health Organization (WHO) created ICF because "functioning" is as great a health concern as disease and mortality.

3. RESULTS

Table 1 presents LIFEware[SM] results for AR based on self-report transformed to linear scales. Numerous items are below expected levels. The expected levels were based on the aggregate means among patients within the database (over 200,000 assessments), all receiving outpatient rehabilitation not stratified by impairment or condition. The aggregate means were used to establish direction for clinical plans. Table 2 presents PAR-PRO™, which shows AR participation in several home and community activities of high importance but low frequency. Spiritual Tendencies Inventory© identified high levels of spiritual strengths, but also obstacles that diminish these strengths. These results are examples of functional health assessments that guide the clinician toward a treatment plan that is quantified and evidence-based with the goal of improving function.

4. CONCLUSION

In addition to identifying organically determined pathophysiological disorders, as recorded on the medical record, it is important to embrace principles of treating the whole person by surveying and measuring patient status on key health subsystems that contribute to functional health.

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Lifeware and PAR-PRO are trademarks of the Uniform Data System for Medical Rehabilitation, a division of UB Foundation Activities Inc. All other trademarks belong to their respective owners.

Table 1. Items within LIFEware® measures below expected levels for AR, 1/15/2010

LIFEware® System				
Body Movement/ Control	***Physical Limitations***	***Painfree***	***Placid***	***Impact on Life***
-68 Getting up	**-41 Right upper limb**	**-86 Punishing**	**-40 Pessimistic**	**-47 Sex**
-61 Standing	**-18 Right lower limb**	**-86 Fearful**	**-12 Irritated**	**-45 Friends**
-45 Reaching	**-15 Fatigue**	**-80 Burning**	**-10 Lonesome**	**-44 Social**
-44 Traveling		**-71 Tiring**		**-34 Household**
-41 Sitting		**-65 Tender**		**-26 Sports**
-25 Kneeling		**-65 Sharp**		**-23 Family**
-23 Lifting		**-53 Aching**		**-13 Travel**
-20 Walking		**-33 Throbbing**		**-3 Work**
-15 Personal care		**-15 Splitting**		
		-12 Cramping		

Table 2. PAR-PRO™ Instrument Profile of Whole-Life Participation for AR, 1/15/2010

Frequency	*Importance*	*Description*
3	3	Work/employment
1	2	School/education
1	3	Volunteer/public service
3	3	Meal preparation/cooking
2	3	Light housework
1	3	Heavy housework
3	3	Caregiver Activities
1	2	Money management/home finances
2	3	Shopping for food/ necessities
1	3	Yard work/gardening/home maintenance
2	3	Hobbies/arts and crafts
2	3	Socializing inside the home
3	3	Socializing outside the home
2	2	Traveling/sightseeing
1	3	Movies/theater/concerts/sporting events
2	3	Playing sports/exercising
3	3	Religious/spiritual activities
1	1	Using public transportation
3	3	Driving a motor vehicle
3	3	Living with another person (not living alone)
Totals		
Frequency	*Importance*	
7 (35%)	16 (80%)	Number of 3s
6 (30%)	3 (15%)	Number of 2s
7 (35%)	1 (5%)	Number of 1s

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